VERTICALLY ORIENTED DUAL CIRCUIT PILOT MASTER CYLINDER

BACKGROUND OF THE INVENTION

[0001] 1. Technical Field:

[0002] The invention relates to vehicle brake systems and more particularly to a pilot master cylinder for the brake system which is positionable inside the vehicle cab.

[0003] 2. Description of the Problem:

[0004] Front engine busses pose a number of problems for engine and vehicle system layout not inherent in conventional or rear engine configurations. Front engine busses have a characteristic flat front or "snub nose" appearance, with the bus driver and engine positioned over the front wheels. The front dash panel is spaced from the front wall of the vehicle by only a few inches. Access to the engine is from the passenger compartment or through relatively small panels in the sides or front of the vehicle. The engine compartment is much smaller than in conventional engine vehicles and components that are located in the engine compartment of conventional engine vehicles, such as brake master cylinders, must frequently be relocated due to size considerations and to considerations relating to providing linkages between operator controls, such as between a brake pedal and the brake master cylinder. For example, in a conventional engine bus a standard horizontally inclined master cylinder may be used where in a front engine bus the master cylinder has frequently had to be relocated due to lack of under hood clearance. On front engine vehicles the brake master cylinder has commonly been located on the vehicle frame, where it is exposed to road splash which poses a corrosion threat.

[0005] Recent developments in vehicle design favor the use of full power brake systems where the brake master cylinder, rather than providing the required pressure for actuating the brakes, provides a hydraulic pilot signal to an electronic

controller, which in turn generates the signals for actuation, modulation and release of the individual wheel end brakes for normal braking, anti-lock braking, stability control and traction control. It would be advantageous to exploit the elimination of the need for power boost to configure a pilot master cylinder which could be repositioned off the frame of the vehicle, preferably to inside the passenger compartment or the under hood compartment to avoid corrosion exposure and improve accessibility.

SUMMARY OF THE INVENTION

[0006] According to the invention there is provided a dual circuit pilot master cylinder for a brake system. A cylinder housing has top and bottom sides and includes fittings for attachment of the cylinder housing to a vehicle dash panel or other advantageous location. A pair of cylinders is disposed in the cylinder housing in parallel to one another and extending vertically into the cylinder housing from adjacent the top side. A piston is positioned in each cylinder for reciprocating motion. A linkage connects to the two pistons to a foot actuated lever for joint up and down movement. The linkage further includes a crank fulcrum positioned on the top side of the cylinder housing and a lever fulcrum depending from the bottom side of the cylinder housing. A crank having opposing ends is mounted for pivoting movement in the crank fulcrum. Piston rods extend from the pistons out of the cylinders for connection to ends of the crank on one side of the crank fulcrum. A brake pedal lever mounted in the lever fulcrum has ends on opposed sides of the lever fulcrum. A push rod extends from a point of connection with an end of the brake pedal lever below the bottom side of the cylinder housing to a point of connection with the an end of the crank above the top side of the cylinder housing. A pedal is disposed on the end of the lever opposite the end connected to the push rod. A working fluid reservoir is mounted on the outside face of the dash panel opposite the cylinder housing and is provided with couplings to the cylinders extending through the dash panel.

[0007] Additional effects, features and advantages will be apparent in the written description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

[0009] **FIG. 1** is a perspective view of a front engine bus with which the invention is advantageously employed.

[0010] **Fig. 2** is a high level schematic of a vehicle brake system.

[0011] **Fig. 3** is a cross sectional view of a dual circuit pilot master cylinder.

[0012] **Fig. 4** is a cross sectional view taken at a right angle with respect to **Fig. 3** of the dual circuit pilot master cylinder.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Referring to the drawings, and particularly to **FIG. 1**, a bus **10** on which the present invention is advantageously employed is illustrated. Bus **10** is a front engine bus with a square front end **13** which maximizes the portion of vehicle length available for passenger seating and which positions a driver close to the front end to improve sight lines. A penalty of this arrangement is more difficult access to the vehicle's engine, which is located behind a flat front wall **12** and which is accessed for checking fluid levels through access doors **14**. The dual circuit pilot master cylinder **20** may of course be used with other types of vehicles, but its novel and non-obvious features lend it particularly useful in vehicles of the type depicted.

[0014] **Fig. 2** illustrates a full power vehicle braking system **15** as may be advantageously used with bus **10** of **Fig. 1**. Braking system **15** incorporates as many wheel end brake units **32** as there are ends of axles on the vehicle. For bus **10** four wheel end brake units **32** are employed. Braking system **15** is actuated by a driver using a dual circuit pilot master cylinder **20** which is mounted on the inside of the vehicle cab from a dash panel **16**. A hydraulic fluid reservoir **22** is mounted on the opposite side of dash panel **16** in a gap **18** between vehicle front wall **12** and the dash panel. A brake pedal **24** depends from dual circuit pilot master cylinder **20** being positioned below the master cylinder and having an actuation arc **A** in a plane that is vertical and perpendicular with respect to dash panel **16**. Dual circuit pilot master cylinder **20** is connected to a full power brake module **30** by a primary hydraulic pilot circuit **26** and a secondary hydraulic pilot circuit **28**. Full power brake module **30** generates control signals for the wheel end brake units **32** in response to the signals received on the pilot circuits and to sensor data (e.g. vehicle speed, wheel lock up, parking brake status, etc.) in accord with the requirements of stopping the vehicle at a rate proportional to the pressure of the pilot signals while maintaining control, avoiding skidding and maintaining vehicle stability. Operation of full power brake module **30** is supported by a full power brake fluid reservoir **122**.

[0015] Referring now to **Figs. 3** and **4**, dual circuit pilot master cylinder **20** is illustrated in detail. Dual circuit pilot master cylinder **20** comprises a housing **120** which encloses primary and secondary circuit cylinders **38** and **40**. The housing **120** is, in a preferred application, hung from its back face **95** on the inside face of a dash panel **16**. A back side **95** of housing **120** is contoured to fit the shape of the face of dash panel **16** and includes flanges **97** which extend beyond the dimensions of housing **120**. Conventional fasteners may be fitted through flanges **97** to hold housing **120** to dash panel **16**. Primary circuit cylinder **38** is disposed upright and parallel to secondary circuit cylinder **40**, the cylinders being located in a vertical plane spaced away from dash panel **16**.

[0016] Brake fluid is supplied to primary and secondary circuit cylinders **38** and **40** from a reservoir **22** located in gap **18** between dash panel **16** and front wall **12**. The fluid is delivered through a conduit **90** to inlets **99** into the cylinders located about half way between the tops and the bottoms of the cylinders. Reservoir **22** is filled with replacement fluid through a fill point **34** accessed via an access door **14** in the vehicle's front wall **12**. Reservoir **22** is conventionally fabricated from plastic and divided by an internal baffle for the primary and secondary circuits. Reservoir fluid level is marked by full and low lines.

[0017] Brake fluid is displaced from cylinders **38, 40** by downward movement of pistons **42, 82** in cylinders **38, 40**. Brake fluid moves out through outlets **89** near the bottommost points in the cylinders through outlet channels **92** to delivery outlets **96** for and into primary and secondary hydraulic pilot circuits **26, 28** (fluid delivery from cylinder **40** to the secondary hydraulic pilot circuit **28** is not shown but is identical to that for the primary hydraulic pilot circuit **26**). Fluid returns to the cylinders **38, 40** with upward movement of pistons **42, 82**. Delivery outlet **96** is tapped by an upwardly slanted primary (and identical secondary) pressure switch port **96**. Both the delivery port **94** and pressure switch port **96** for both the primary and secondary systems pass through the dash panel **16** for connections inside gap **18**. The areas around all outlets are bossed to extend through openings in dash panel **16** to ease making the appropriate switch and hydraulic circuit connections.

[0018] Cylinders **38, 40** are located in a side by side arrangement in housing **120** which are outwardly displaced from dash panel **16** and located near the front face **101** of the housing. Cylinders **38, 40** are vertically oriented and pistons **42, 82** are disposed in the cylinders for reciprocating up and down movement. Extending upwardly from pistons **42, 82** are piston rods **44, 84**, respectively. Piston rods **44, 84** extend through openings **78, 80** in an upper cover plate **36** to pin connections **54, 154** in tines **74, 76** of a forked bell crank **48**. Pistons **42, 82** are upwardly biased in position by rebound compression springs **46, 86** located in cylinders **38, 40** between the pistons and the bottoms of the cylinders. Pistons **42, 82** are of piston and follower design to better maintain alignment and relieve stress from piston seals **98**.

[0019] Pistons **42**, **82** are manually operated by force applied to a brake pedal **24** hung below housing **120**. Pedal **24** swings in an arc **A** (shown in **Fig. 2**) which is located in a vertical plane perpendicular to dash panel **16**. Brake pedal **24** is connected to pistons **42**, **82** by a linkage which assures that pistons **42**, **82** move in unison. The linkage comprises: piston rods **44**, **84**; forked bell crank **48**; a push rod **56**; and a pedal lever **64**. Forked bell crank **48** is supported at a fixed point above housing **120** on upper cover plate **36** by a crank fulcrum **50**. Pedal lever **64** hangs from a fixed point below housing **120** from a pedal lever fulcrum **68** extending from bottom side **70** of the housing. Forked bell crank **48** is connected to crank fulcrum **50** on a pin **52** through a central member **53** of the forked bell crank which allows the forked bell crank to rock back and forth from end to end. Similarly, pedal lever **64** is supported by a pin **88** through a centered location allowing the pedal lever to pivot. Pins **52** and **88** are parallel to back side **95** of housing **120** and to one another. Each is positioned horizontally making the planes of rotation of forked bell crank **48** and pedal lever **64** coincident. Forked bell crank **48** and pedal lever **64** each have inner ends close to dash panel **16** and outer ends distal to the dash panel. Forked bell crank **48** divides into two tines **74** and **76** on its side distal to dash panel **16**. Brake pedal **24** is mounted to the outer end of pedal lever **64** distal to dash panel **16**. Piston rods **44**, **84** are pivotally pinned to forked bell crank **48** away from dash panel **16** to take stress off of piston seals **98**.

[0020] Pedal lever **64** is linked to forked bell crank **48** by a push rod **56** positioned to pass through a space in the back of housing **120** between the housing and dash panel **16**. Push rod **56** is connected to the inner ends of forked bell crank **48** and pedal lever **64**. Pivot pins **62** and **66** provide the means of connection between the respective ends of push rod **56** and forked bell crank **48** and pedal lever **64**, respectively. Depression of brake pedal **24** thus is transmitted to forked bell crank **48** by upward movement of push rod **56**, and corresponding, joint downward movement of piston rods **44**, **84**. The motion is coupled to the pair of pistons **42**, **82** imparting to the pistons joint up and down motion in the cylinders with the foot actuated pedal lever **64** having a motion in a vertical plane perpendicular to the dash panel **16**.

[0021] Forked bell crank **48** divides into first and second tines **74**, **76** on the end away from the point of connection to push rod **56**. This allows pedal lever **64** to be centered between cylinders **38**, **40**.

[0022] The invention provides for an internally mountable dual hydraulic circuit pilot master cylinder for a motor vehicle brake system that fits into a foot print as small as those for an air brake system valve package. The system reservoir is readily positioned for ease of access on a variety of vehicle types. The arrangement of the system also makes it largely self bleeding and provides a readily accessible point for mounting of a pressure switch and for final bleeding of both pilot delivery circuits.

[0023] While the invention is shown in only one of its forms, it is not thus limited but is susceptible to various changes and modifications without departing from the spirit and scope of the invention.